



Using a 3D Global Model (**IMPACT**) to  
Understand the Role of In-Situ Production  
and Stratospheric Transport on Tropospheric O<sub>3</sub>  
at Specific North American Locations

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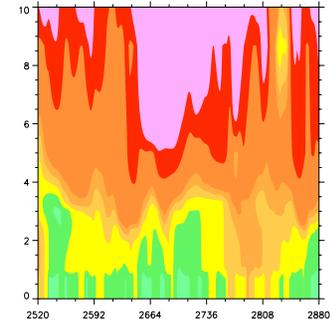
# IMPACT is a global, 3D model

## Chemistry

Troposphere and stratosphere

≈200 species - CO, CH<sub>4</sub>, NO, NO<sub>2</sub>, OH, O<sub>3</sub>, C<sub>2</sub>H<sub>6</sub>, C<sub>3</sub>H<sub>8</sub>, isoprene, C<sub>3</sub>H<sub>6</sub>, C<sub>4</sub>H<sub>8</sub>, H<sub>2</sub>O<sub>2</sub>, HO<sub>2</sub>, PAN, ...

Aerosols: SO<sub>4</sub><sup>2-</sup>, organic & black carbon, mineral



## Meteorology

Assimilated or GCM

## Resolution

Met dependent; 2.5°(lon) x 2.5°(lat) x 46 levels

## Processes

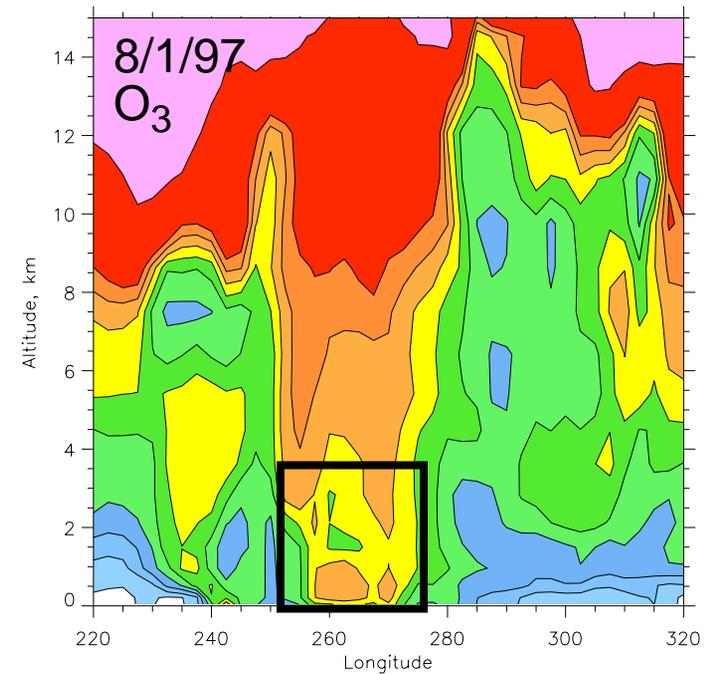
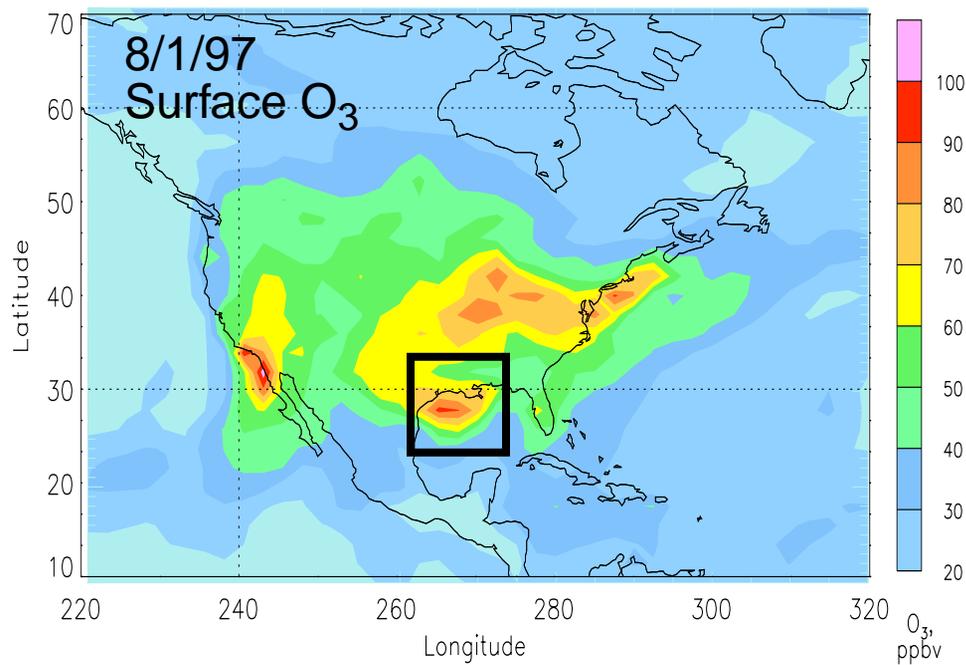
Chemistry, photolysis, advection, diffusion, wet & dry deposition

- > *Important processes governing tropospheric oxidants/aerosols*
- > *Compare with measurements from specific time period*
- > *Provide initial and boundary conditions for other scale models*



# IMPACT model contributions

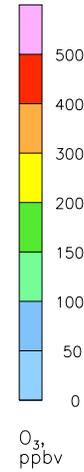
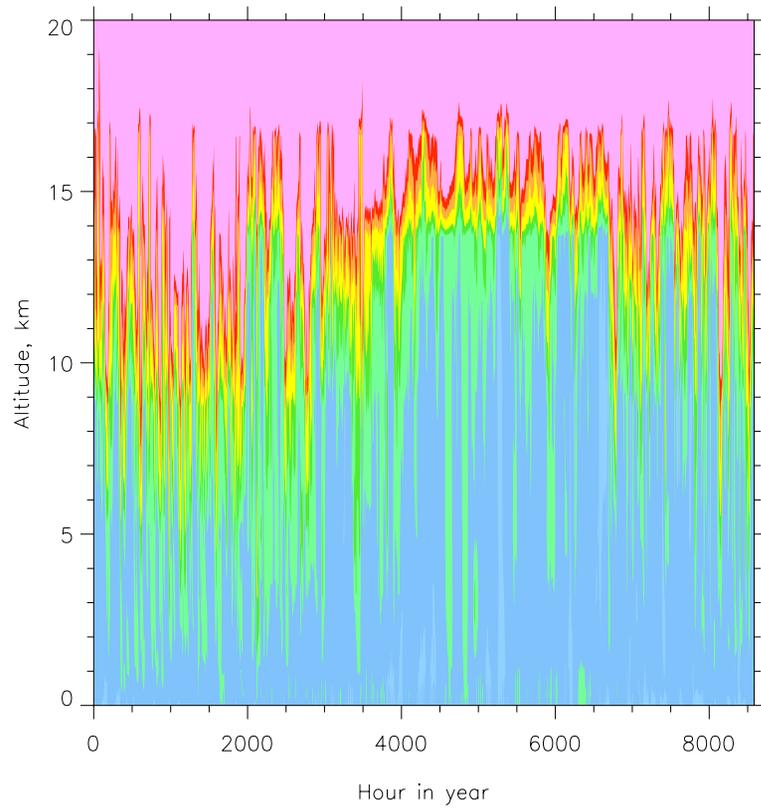
- Provide context - “bigger picture”
- Fill sampling “gaps” (above, below, upwind, downwind)
- Analyze local photochemistry versus transport
- Isolate effects through sensitivity studies
- Provide initial and boundary conditions for other scale models



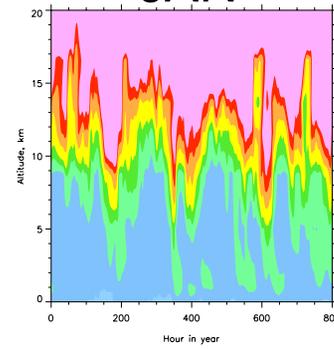


# IMPACT result: Houston O<sub>3</sub> varies seasonally

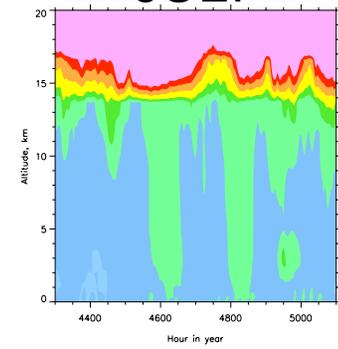
## Year 1997



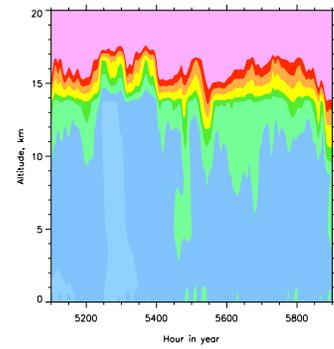
### JAN



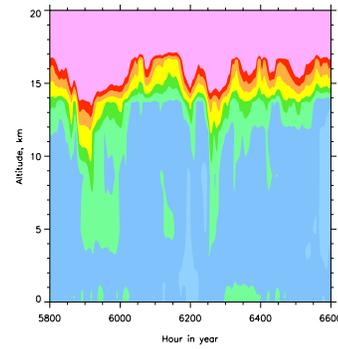
### JULY



### AUG

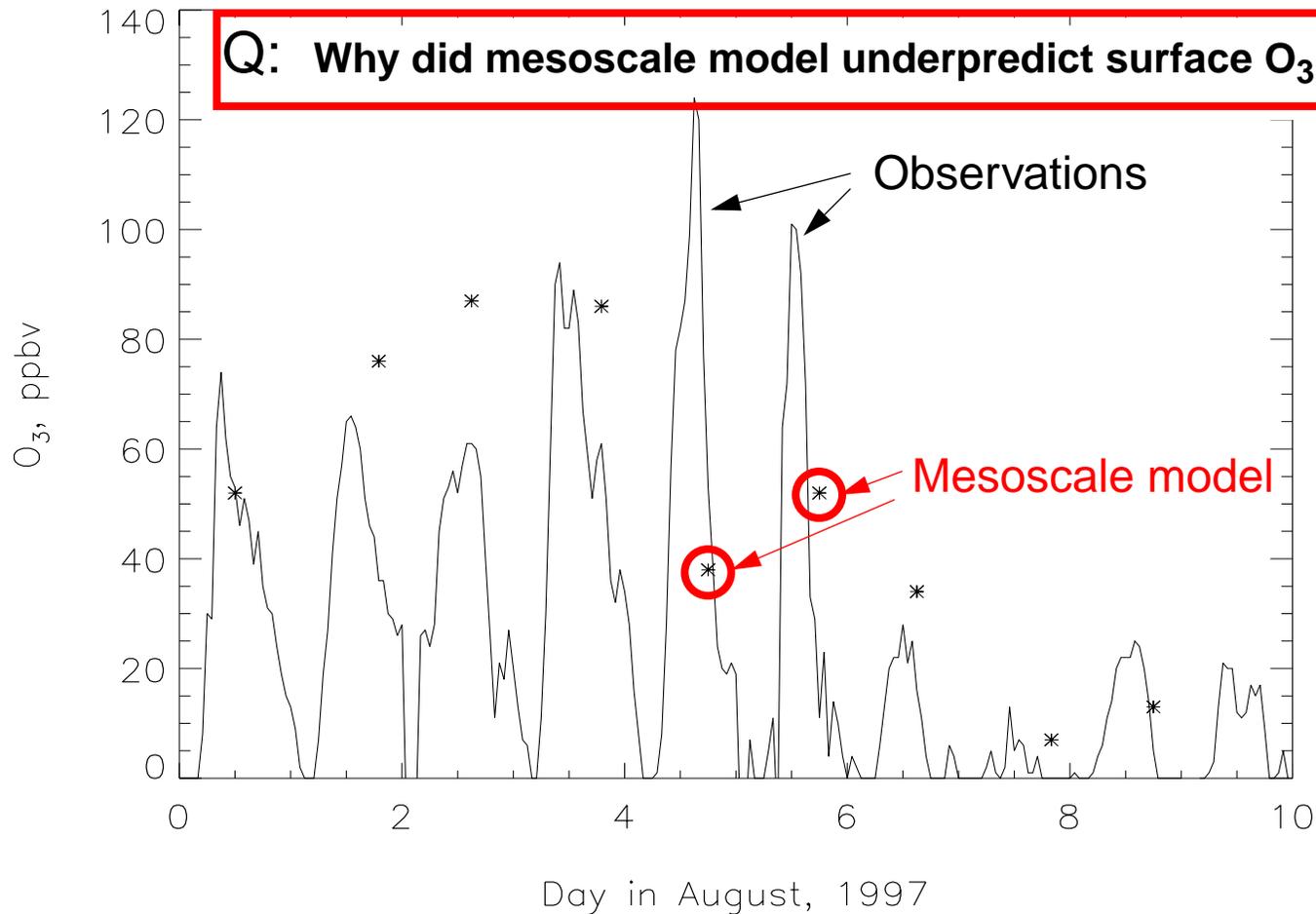


### SEPT





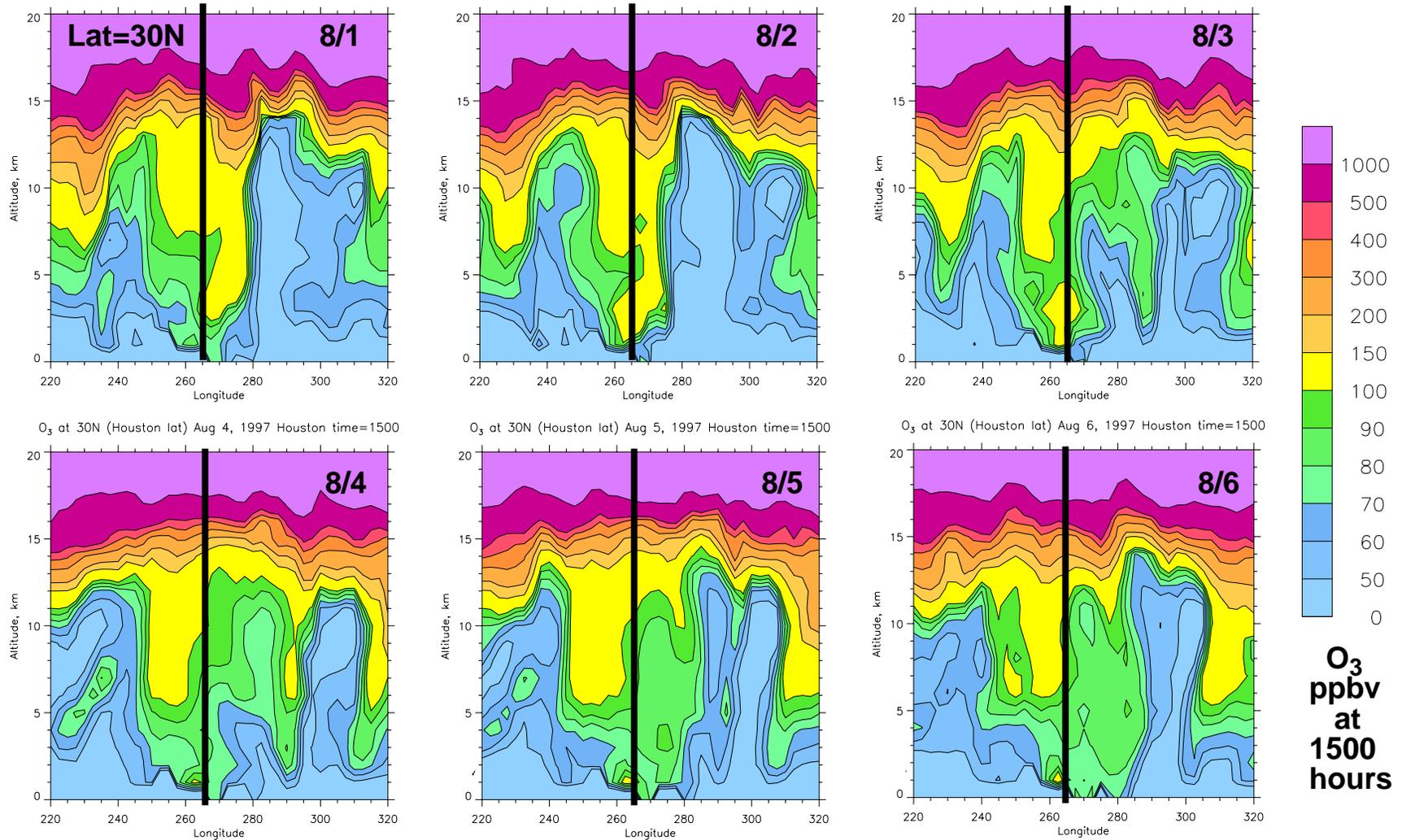
# IMPACT Study: Houston - Aug. 1-10, 1997



**(Draxler, 2000)**

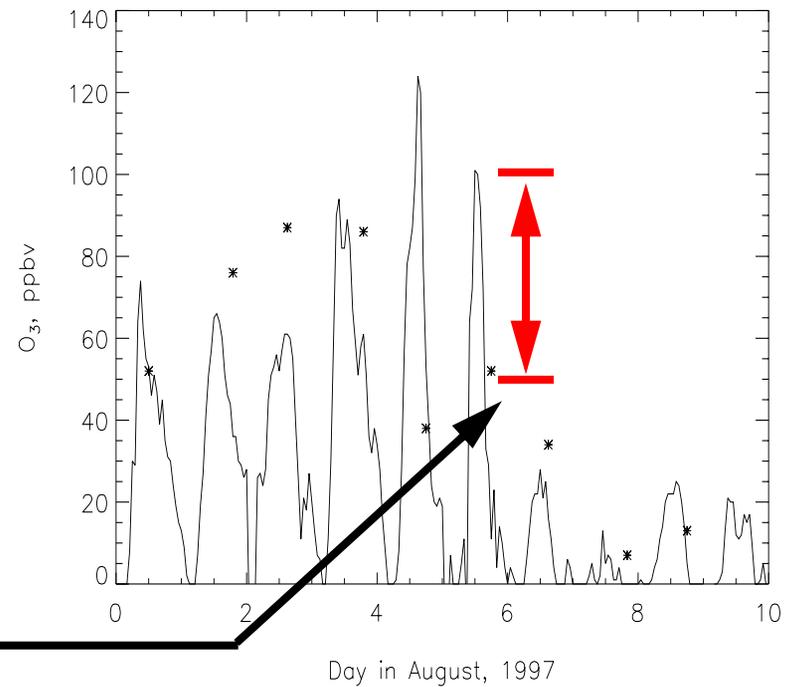
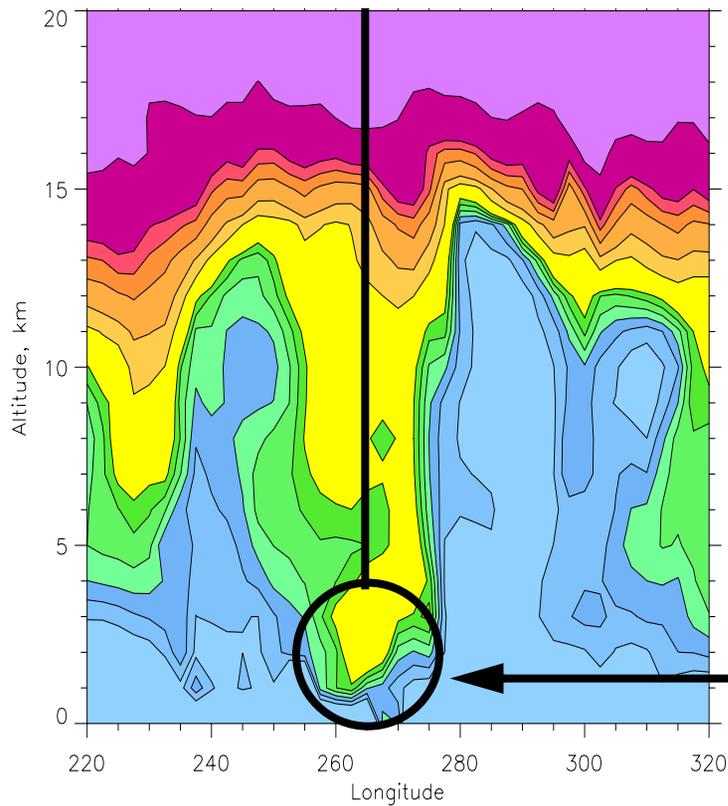


# IMPACT vertical O<sub>3</sub> cross sections at 30°N show influence from aloft starting Aug. 1, 1997 (Houston ~ 265°)



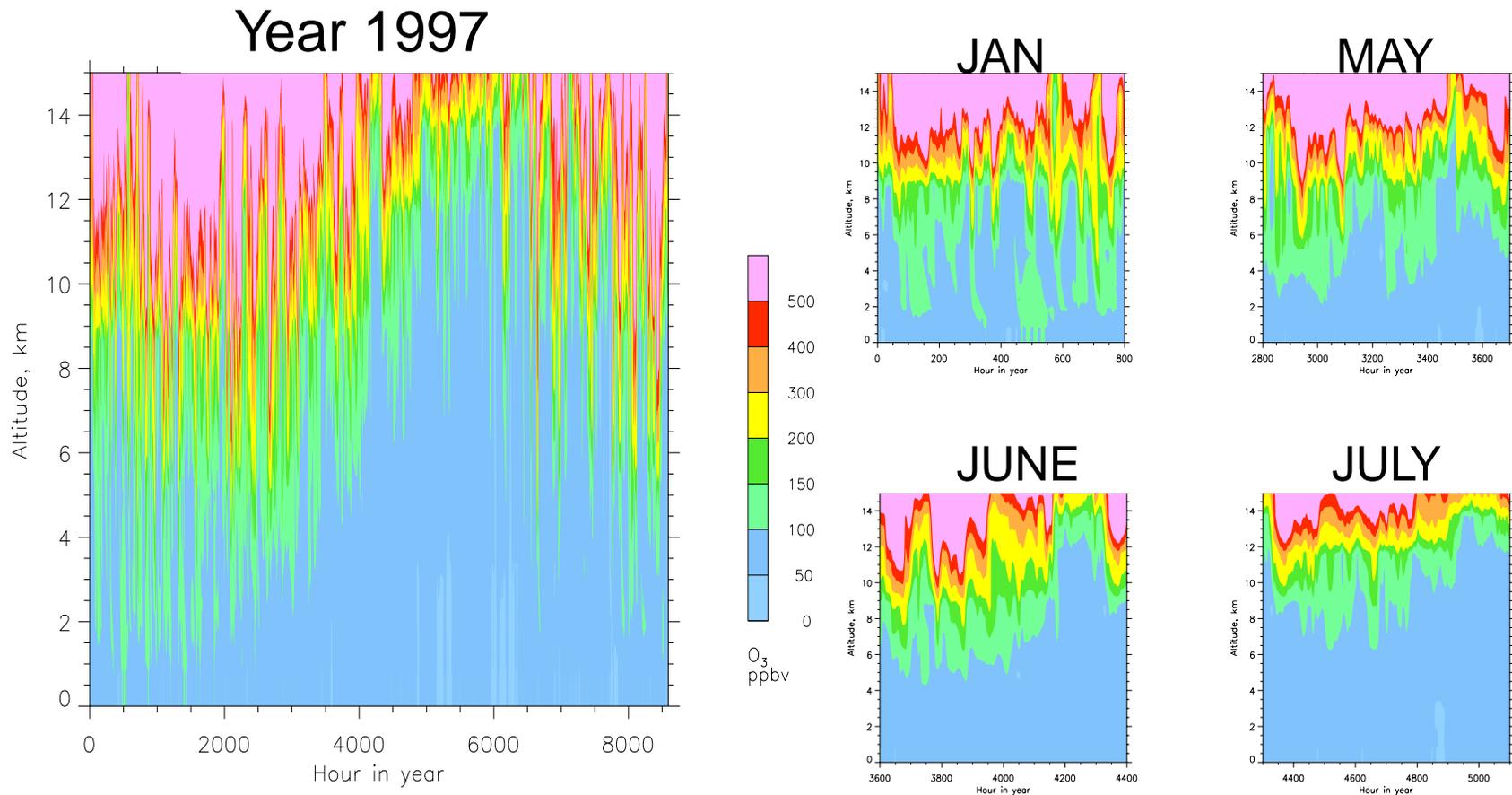


The O<sub>3</sub> transport from aloft may increase “background” troposphere levels, onto which surface processes add

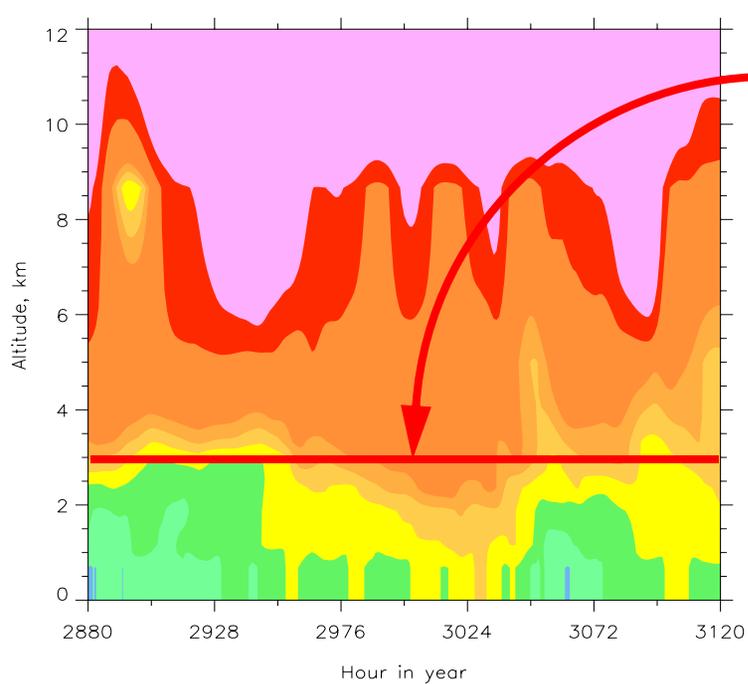




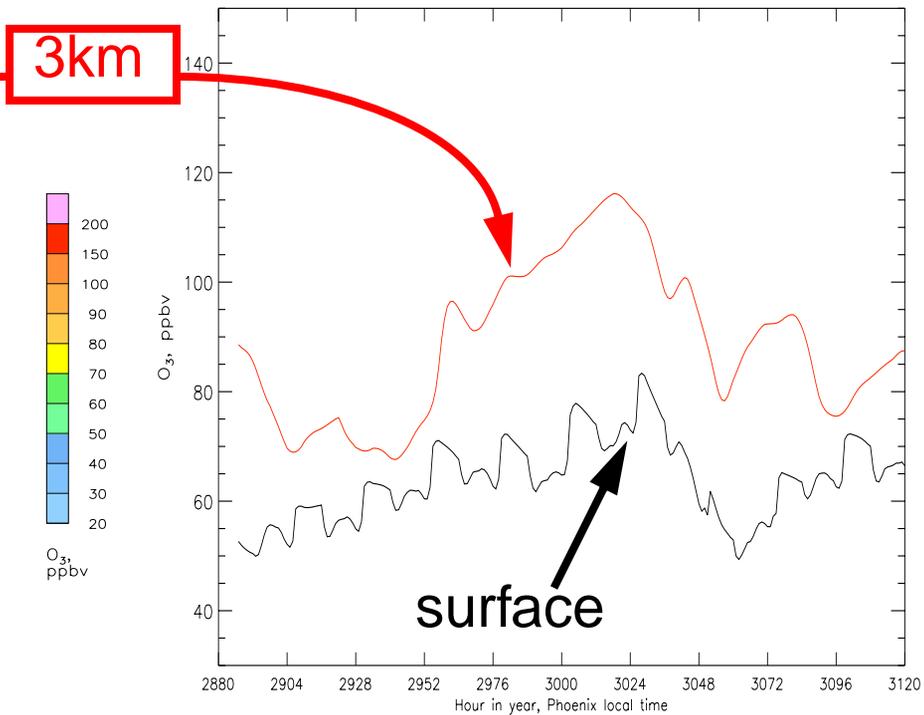
# IMPACT result: Phoenix O<sub>3</sub> varies seasonally



# IMPACT results: Aloft air and Phoenix O<sub>3</sub>: May 1 - 10, 1997



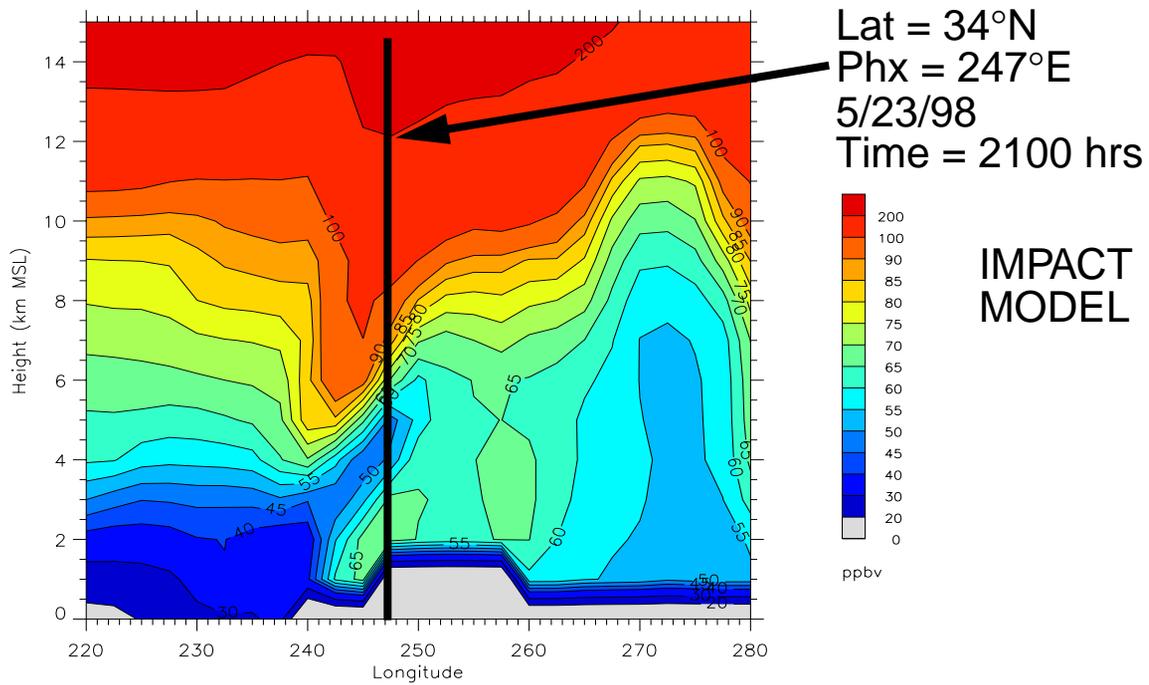
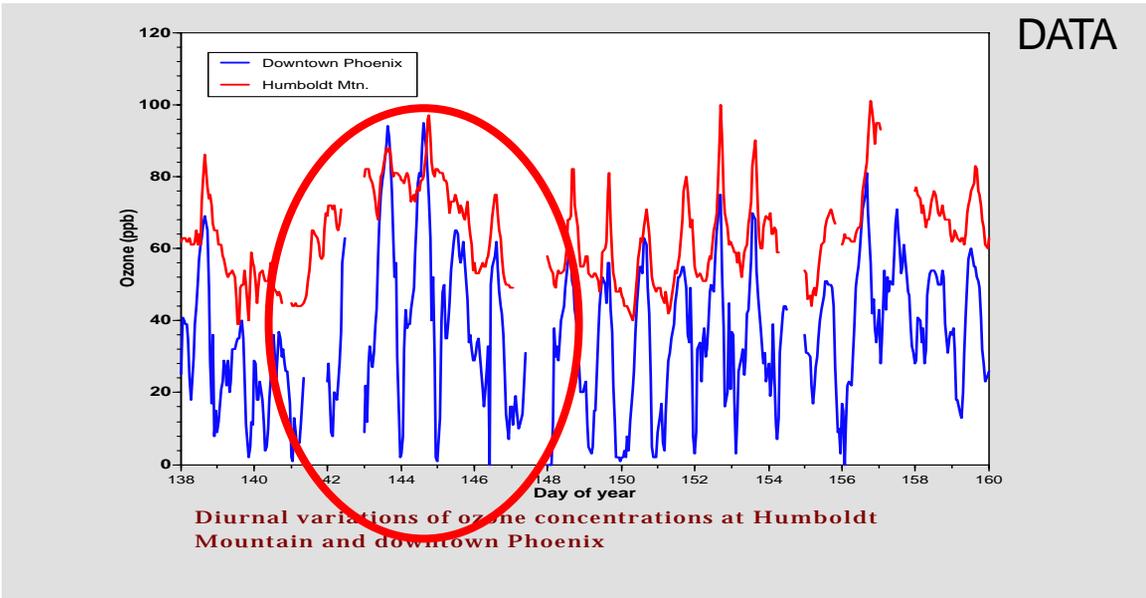
o3\_phx\_may1to15\_Jst.ps



phx\_o3\_may1to10\_97\_1000.ps

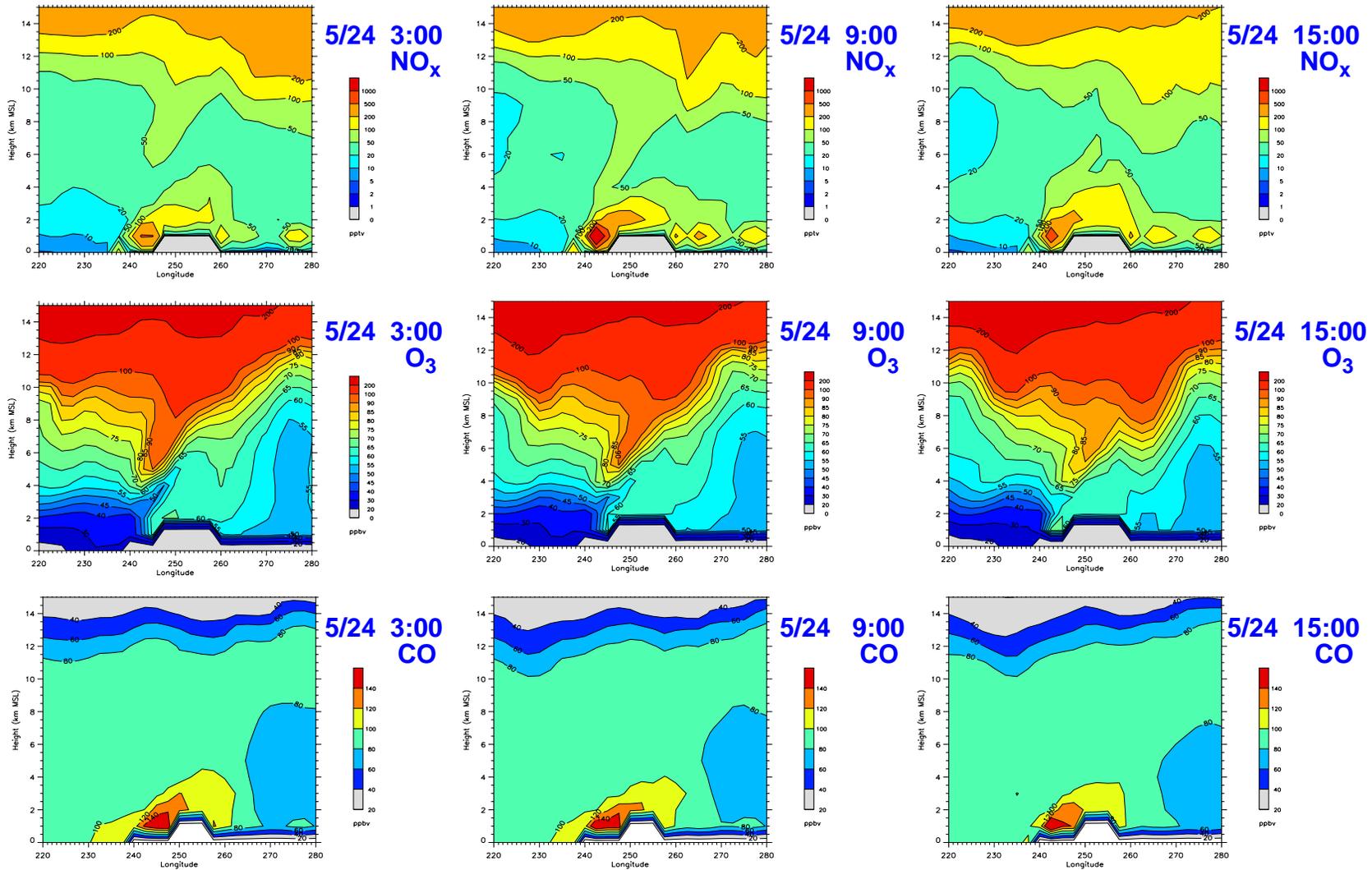


Air aloft influenced Phoenix surface O<sub>3</sub> during May 22-26,  
1998?





# IMPACT results: $\text{NO}_x$ , $\text{O}_3$ and CO at $34^\circ\text{N}$ affected by surface and aloft processes on 5-24-98 (Phoenix ~ $247^\circ$ ) ?

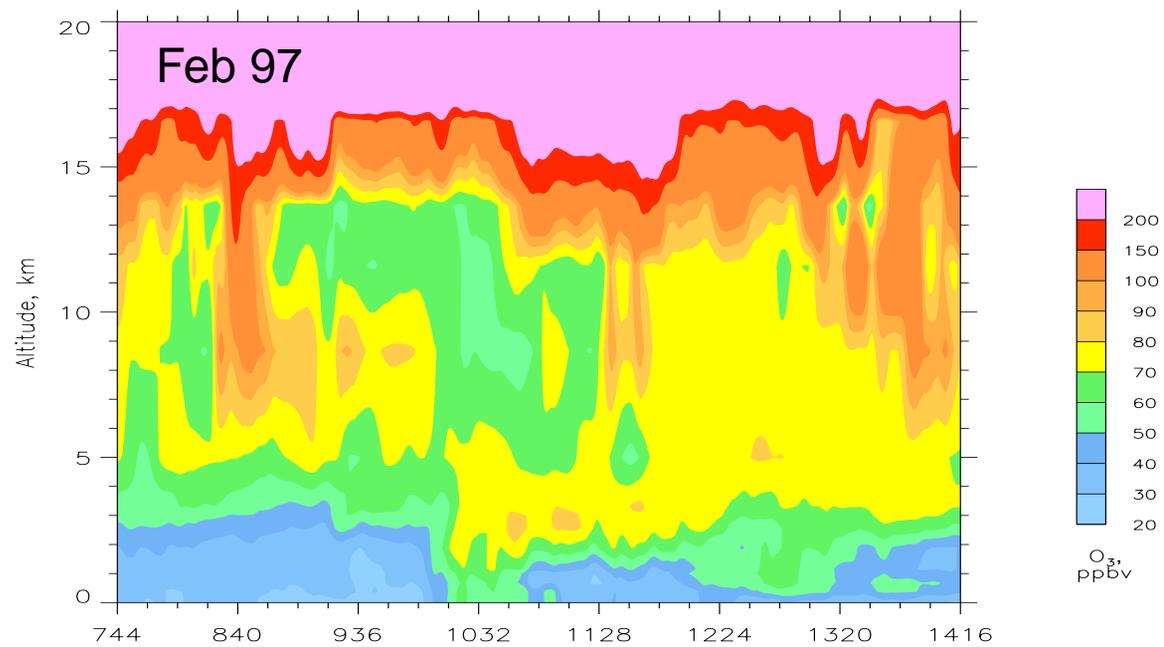
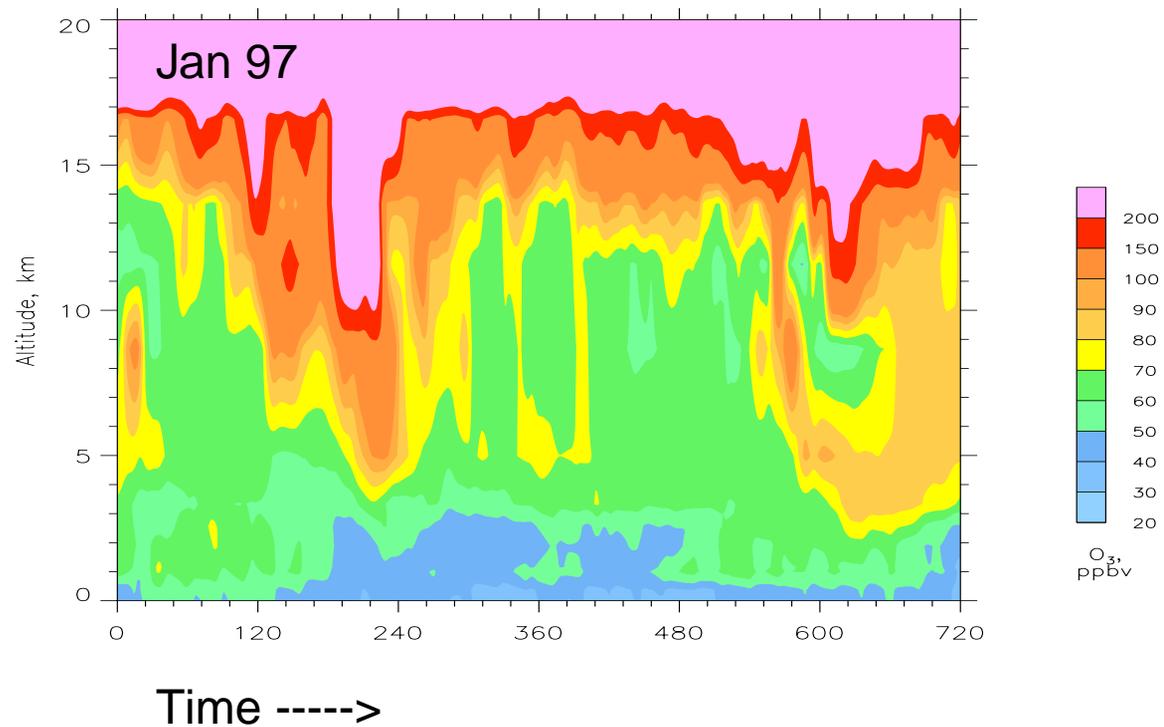




IMPACT O<sub>3</sub>: Jan/Feb '97 (13N, 59W)(Barb.)

[Puerto Rico ~ (18N, 66W)]







## IMPACT model future studies

- Model results <---> field campaigns
  - (Phoenix, California, Puerto Rico, Northeast, ...)
  - “Fill” sampling gaps; provide **context**
  - Roles of local photochemistry & transport
- Acquire new assimilated meteorology (1998 --->)
- Future sensitivity studies
  - Role of oxidants and aerosols and energy use
  - Increased ---- Decreased (controlled) --- Redistributed energy use